



NTSB National Transportation Safety Board

Collaboration for Managing Risk in Complex Systems: An Aviation Industry Success Story

Presentation to:

7th Annual DFG-NSF Conference

Name: Christopher A. Hart

Date: October 3, 2012

The Pleasant Surprise

- Conventional Wisdom:

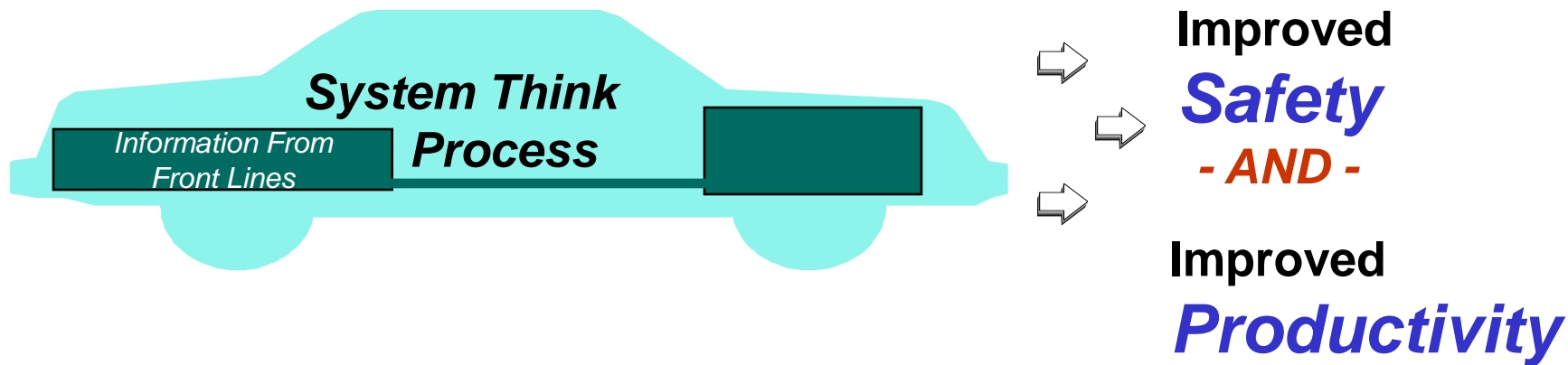
Improvements that reduce risk usually
also reduce productivity

- Lesson Learned from successful aviation industry safety processes:

Risk can be reduced in a way that also results in
immediate productivity improvements



Process Plus Fuel: A Win-Win



The Challenge: Increasing Complexity

- **More System**

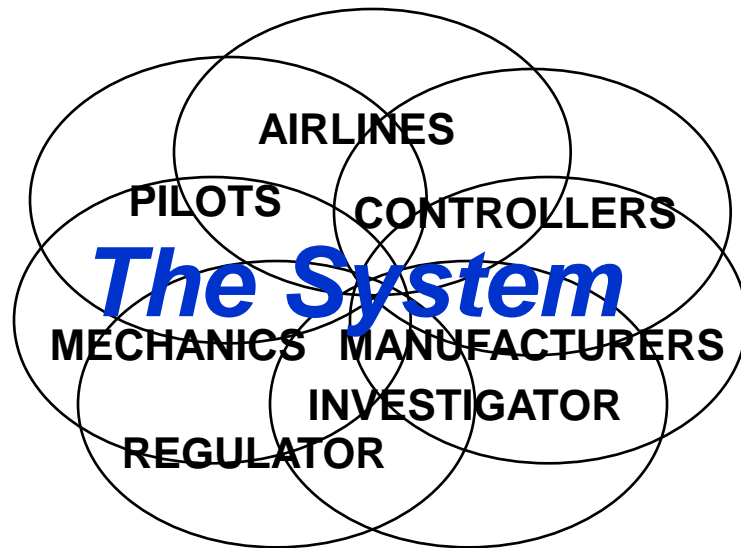
- Interdependencies*

- Large, complex, interactive system
 - Often tightly coupled
 - Hi-tech components
 - Continuous innovation
 - Ongoing evolution

- **Risk Management**

**Issues Are More
Likely to Involve**

***Interactions Between
Parts of the System***



Effects of Increasing Complexity:

More “Human Error” Because

- System More Likely to be Error Prone
- Operators More Likely to Encounter Unanticipated Situations
- Operators More Likely to Encounter Situations in Which “By the Book” May Not Be Optimal (**“workarounds”**)



The Result:

Front-Line Staff Who Are

- Highly Trained
 - Competent
 - Experienced,
 - Trying to Do the Right Thing, and
 - Proud of Doing It Well
- . . . Yet They Still Commit

Inadvertent Human Errors



The Solution: System Think

***Understanding how a
change in one subsystem
of a complex system may
affect other subsystems
within that system***



Objectives:

Make the System

***(a) Less
Error Prone***

and

***(b) More
Error Tolerant***



The Health Care Industry ***To Err Is Human:***

Building a Safer Health System

“The focus must shift from blaming individuals for past errors to a focus on preventing future errors by designing safety into the system.”

**Institute of Medicine, Committee on Quality of Health
Care in America, 1999**



Major Paradigm Shift

How It Is Now . . .

You are highly trained
and

If you did as trained, you
would not make mistakes

so

You weren't careful enough

so

You should be **PUNISHED!**

How It Should Be . . .

You are human
and

Humans make mistakes

so

Let's *also* explore why the system
allowed, or failed to accommodate,
your mistake

and

Let's **IMPROVE THE SYSTEM!**



“System Think” via Collaboration

Bringing all parts of a complex system together to collaboratively

- **Identify potential issues**
- ***PRIORITIZE* the issues**
- **Develop solutions for the prioritized issues**
- **Evaluate whether the solutions are**
 - **Accomplishing the desired result, and**
 - **Not creating unintended consequences**



Aircraft Manufacturer “System Think”

Aircraft manufacturers are increasingly seeking input, from the earliest phases of the design process, from

- *Pilots* (User Friendly)
- *Mechanics* (Maintenance Friendly)
- *Air Traffic Services* (System Friendly)



Aviation System Collaboration

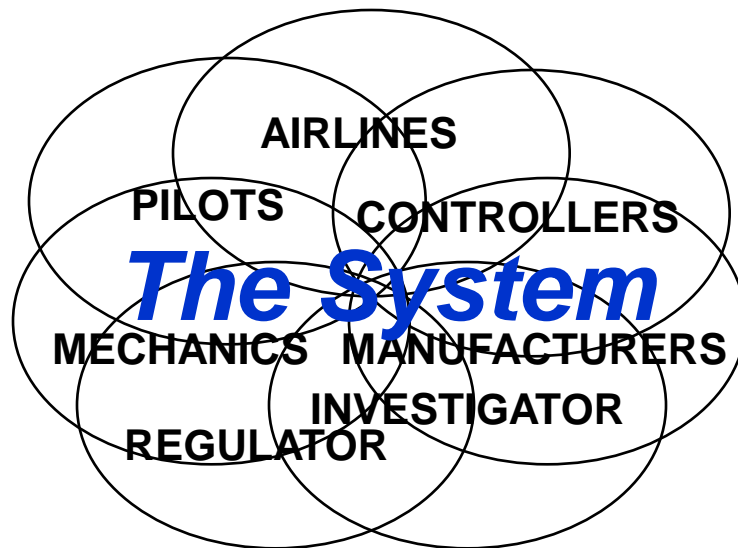
- Mid-1990's, U.S. fatal commercial accident rate, although commendably low, had stopped declining
- Volume of commercial flying was projected to double within 15-20 years
- Simple arithmetic: Doubling volume x flat rate = *doubling of fatal accidents*
- Major problem because public pays attention to the *number* of fatal accidents, not the *rate*



Commercial Aviation Safety Team (CAST)

Engage All Participants In Identifying Problems and Developing and Evaluating Remedies

- Airlines
- Manufacturers
- Air Traffic Organizations
- Labor
 - *Pilots*
 - *Mechanics*
 - *Air traffic controllers*
- Regulator(s)



Collaboration Success Story

65% Decrease in Fatal Accident Rate, 1997 -
2007

largely because of

System Think

fueled by

***Proactive Safety Information
Programs***

P.S. Aviation was already considered **VERY SAFE** in 1997!!

P.P.S. The process did not generate ***any new regulations!***



Major Paradigm Shift

- **Old: The regulator identifies a problem, develops solutions**
 - Industry skeptical of regulator's understanding of the problem
 - Industry fights regulator's solution and/or implements it begrudgingly

- **New: Collaborative “System Think”**
 - Industry involved in identifying problem
 - Industry “buy-in” re solution because everyone had input, everyone's interests considered
 - Prompt and willing implementation
 - Solution probably more effective and efficient
 - Unintended consequences much less likely



Challenges of Collaboration

- Human nature: “I’m doing great . . . *the problem is everyone else*”
- Differing and sometimes competing interests
 - Labor-management issues between participants
 - Participants are potential adversaries
- Regulator not welcome
- Not a democracy
 - Regulator must regulate
- Requires all to be willing, in their enlightened self-interest, to leave their “comfort zone” and think of the System



The Role of Leadership

- Demonstrate Safety Commitment . . .
But Acknowledge That Mistakes Will Happen

- Include “Us” (e.g., System) Issues,

- Not Just “You” (e.g., Training) Issues

- **Make Safety a Middle Management Metric**

- Engage Labor Early

- Include the *System* --

Manufacturers, Operators, Regulator(s), and Others

- Encourage and Facilitate Reporting

- Provide *Feedback*

- Provide Adequate *Resources*

- *Follow Through* With Action



How The Regulator Can Help

- Emphasize importance of System issues
in addition to (not instead of) worker issues
 - Encourage and participate in
industry-wide “System Think”
- Facilitate collection and analysis of information
 - Clarify and announce *policies for protecting information and those who provide it*
 - Encourage other industry participants
to do the same
- Recognize that *compliance* is very important,
but the *mission is reducing systemic risk*



Aviation Win-Win: Transferable to Other Industries?

- Other Transportation Modes**
- Nuclear Power**
- Chemical Manufacturing**
- Petroleum Refining**
- Financial Industries**
- Healthcare**
- Others**



Thank You!!!



Questions?

